Conservation of Energy

6-5 The student will demonstrate an understanding of the law of conservation of energy and the properties of energy and work. (Physical Science)

6-5.5 Illustrate the directional transfer of heat energy through convection, radiation, and conduction.

Taxonomy level: 2.2-B Understand Conceptual Knowledge

Previous/Future knowledge: In 3rd grade (3-4.3), students explained how heat moves easily from one object to another through direct contact in some materials (called conductors) and not so easily through other materials (called insulators). Students have not been introduced to the concepts of radiation or convection. Students will further develop the concept of thermal energy in high school Physical Science (PS-6.1).

It is essential for students to know energy transfer as heat can occur in three ways:

Conduction

- Conduction involves objects in direct contact.
- The transfer of energy as heat occurs between particles as they collide within a substance or between two objects in contact.
- All materials do not conduct heat energy equally well.
- Poor conductors of heat are called insulators.
- The energy transfers from an area of higher temperature to an area of lower temperature.
- For example, if a plastic spoon and a metal spoon are placed into a hot liquid, the handle of the metal spoon will get hot quicker than the handle of the plastic spoon because the heat is conducted through the metal spoon better than through the plastic spoon.

Convection

- Convection is the transfer of energy as heat by movement of the heated substance itself, as currents in fluids (liquids and gases).
- In convection, particles with higher energy move from one location to another carrying their energy with them.
- Heat transfer occurs when particles with higher energy move from warmer to cooler parts of the fluid.
- Uneven heating can result in convection, both in the air and in water. This causes currents in the atmosphere (wind) and in bodies of water on earth which are important factors in weather and climate.

Radiation

- Radiation is the transfer of energy through space without particles of matter colliding or moving to transfer the energy.
- This radiated energy warms an object when it is absorbed.
- Radiant heat energy moves from an area of higher temperature to an area of cooler temperature.

It is not essential for students to know about areas of higher or lower density of fluids. They also do not need to know about electromagnetic waves being transferred in radiation.

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Assessment Guidelines:

The objective of this indicator is to *illustrate* the directional transfer of heat energy through conduction, convection, and radiation; therefore, the primary focus of assessment should be to give illustrations or use illustrations to show the concept of heat transfer through conduction, convection, or radiation. However, appropriate assessments should also require students to *recognize* the types of heat transfer based on descriptions of how particles behave; *classify* methods of heat transfer based on how particles behave; *infer* the direction of heat transfer; or *summarize* the direction of heat transfer in various types of heat transfer processes if given temperature differences.